II. 0·2653 gramme of carefully selected substance, evaporated with an excess of ammonium fluoride, left 0·0021 gramme residue, chiefly iron oxide.

This determination denotes the following percentage composition:—

Silicic acid	[99·21]
Iron oxide, &c.	0·79
	100·00

Besides the distinct cleavage parallel to the plane 0 0 1 already alluded to, and the other, less distinct, parallel to the planes of the form (1 0 1), there seem also to be divisional planes or, rather, surfaces along which the crystals break up with the greatest facility; even drying them on blotting-paper proving often sufficient to destroy the integrity of specimens that might otherwise seem to promise good results to the goniometer.

Partsch,* in his description of the Vienna Collection of Meteorites, identifies as a specimen of the Steinbach siderolite a fragment with a label, "Native iron, jagged and hackly, with quartz in grains and a yellow fluor-spar" (*gediegenes, zahnicht und zackicht gewachsenes Eisen mit körnichtem Quarz und gelblichtem Flussspath*).

Breithaupt†, in his paper describing the Rittersgrün Siderolite, makes its chief silicate to be peridot. It is doubtless bronzite. In addition to troilite and schreibersite, he records the presence of "another mineral, the composition of which is not yet determined."

It should be mentioned that, with a view to test the relative solvent action of alkaline carbonates on quartz and the meteoric silica, weighed portions of each were digested with a ten per cent. solution of sodium carbonate for ten hours at 100° C. under precisely similar conditions. Of the quartz 7·843 per cent. had dissolved, of the Breitenbach silica 9·437 per cent.

The Shalka Meteorite.

An examination of the Shalka meteorite, also detailed in the same memoir, gave as a result that this meteorite consists mainly of a bronzite of the formula $Mg_{\frac{3}{4}}\ Fe_{\frac{1}{4}}\ Si\ O_3$, and is therefore identical in composition with, though very different in appearance and structure from, that of the meteorite of Manegaum.

HEAT GENERATED BY METEORIC STONES IN TRAVERSING THE ATMOSPHERE

As supplementary to my short article on the "Maximum Velocity of Meteoric Stones Reaching the Surface of the Earth" (NATURE, Sept. 14, 1871, vol. iv. p. 398), permit me to add the following observations in relation to the source and the amount of the heat generated by such masses in traversing the atmosphere.

It is well known that the observations of Glaisher, Petit, Daubrée, and others, establish the fact that these bodies enter our atmosphere with velocities which are truly planetary. For example, the meteorite of Orgueil moved with a velocity of at least 20 kilometres (12·43 miles) per second, while in other cases velocities have been observed which could not be observed at less than from 15 to 30, or even 40 miles per second. The enormous resistance encountered by such bodies in traversing the air (as we have seen in the previous article), speedily extinguishes this high velocity, so that they retain but a comparatively moderate velocity on reaching the surface of the earth.

Now, the "Dynamical Theory of Heat" assures us that whatever energy is lost by the moving body is transformed into heat, which is either retained by the body or is communicated to the air. The amount of heat thus generated can be estimated, provided the diminution of velocity and the mass of the meteoric stone are known. More than 23 years ago Dr. Joule pointed out this transformation of energy into heat as the true cause of the ignition of these extra-terrestrial masses in traversing the air (*Vide* Phil. Mag., 3rd Series, vol. xxxii., p. 349, May 1848).

According to Joule's experiments, one French unit of heat = 423·5424 kilogrammetres or units of energy. Hence, one

$$\text{French unit of energy} = \frac{1}{423{\cdot}5424} = 0{\cdot}00236104 \text{ French units of heat.}$$

If, therefore,

v = velocity of stone upon entering the atmosphere,
v_1 = ,, ,, ,, when near the earth's surface,
g = acceleration produced by gravity,
w = weight of moving stone in kilogrammes:

Then if v, v_1, and g are taken in metres per second, we have,

$$\text{Loss of energy} = w \,.\, \frac{v^2 - v_1^2}{2g}.$$

This loss of energy transformed into heat =

$$0{\cdot}00236104 \times w \,.\, \frac{v^2 - v_1^2}{2g} \text{ French units of heat.}$$

Assuming $g = 9{\cdot}80942$ metres per second, we have,

French units of heat generated $= 0{\cdot}000120345 \times w \times (v^2 - v_1^2)$. This gives the total amount of heat evolved by the loss of energy.

Now, if we knew the distribution of the heat thus generated, it would be easy to estimate the increase of temperature which it would occasion in the matter to which it is imparted. If we assume all of the heat evolved to be retained by the moving body, it is evident that the increase of temperature ($v^2 - v_1^2$ being the same) is inversely proportional to the product of the weight into the specific heat of the moving mass.

Hence, if c = specific heat of stone in relation to water as unity, we have,

$$\text{Increase of temperature in C}^\circ = 0{\cdot}000120345 \times \frac{w\,(v^2 - v_1^2)}{w \times c}\text{; or}$$

$$\text{Increase of ,, ,,} = 0{\cdot}000120345 \times (v^2 - v_1^2) \times \frac{1}{c}. \quad (a)$$

Under the assumption that all of the heat generated is retained by the moving mass, it is obvious that w is eliminated; for, while the heat evolved varies as w, the mass to be heated also varies as w; so that the weight is without influence, in so far as increase of temperature is concerned.

In order to apply this formula to any given case, we must know v, v_1, and c in relation to the moving stone. Perhaps we should not be over-estimating v by assuming it to be 30 kilometres per second, or nearly equal to the velocity of the earth in its orbit. In like manner we should certainly not be under-estimating v_1 by assuming it equal to 500 metres per second. Substituting these values in formula (a), and we have,

$$\text{Increase of temp. in C}^\circ = 0{\cdot}000120345\,(30000^2 - 500^2) \times \frac{1}{c}\text{; or}$$

$$\text{Increase of ,, ,,} = 108530 \times \frac{1}{c}.$$

Finally, in the absence of experimental results in regard to the specific heat of meteoric stones, we are certainly not under-estimating c by assuming it equal to 0·22.

Substituting this value of c in the last equation, and we have,

Increase of temp. in C° = 492,184°.

Of course, by far the larger portion of the heat generated by the loss of energy of the moving stone would be imparted to the air along its trajectory; but assuming that only $\frac{1}{100}$th part of it is retained by the stone, it would be more than sufficient to account for the phenomena of fusion and detonation which frequently accompany the transit of such bodies through our atmosphere.

In the case of small masses, it is clear that their high velocities would be more rapidly extinguished by the resistance of the air than is the case with large masses. In the small mass the transformation of energy into heat being accomplished in a shorter time, a greater amount of the evolved heat would be retained by the stone than in the large mass whose velocity is more gradually checked by the resisting medium.

Hence, when the smaller masses plunge into the upper atmosphere, the matter may be volatilised or utterly dissipated by the intensity of the suddenly-evolved heat. In this minutely-divided condition the material of the stones would float about in the atmosphere, and ultimately reach the surface of the earth in the form of meteoric dust.

It is well known that the observations of Benzenberg, Quetelet, Herrick, Newton, and others, assign to the so-called "falling stars" velocities equal to, if not surpassing, the velocities of meteoric stones. According to the foregoing suggestion, these may be nothing more than small meteoric stones which are volatilised in the upper regions of the atmosphere long before reaching the surface of the earth.

Thus, the phenomena of the occasional fall of meteoric stones and the almost incessant appearance of the falling stars which nightly furrow the celestial vault, may be correlated with the

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* Die Meteoriten im k. k. Hof-Mineralien-Kabinette. Wien, 1843, p. 95.

† Berg und Hütt. Zeitung, xxi. p 321.

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principle of transformation of energy. At all events, all the luminous, thermic, and detonating phenomena attending the fall of such bodies seem to be fully accounted for by the enormous amount of heat thus generated by their passage through the atmosphere. JOHN LE CONTE

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SCIENTIFIC SERIALS

Annalen der Chemie und Pharmacie, November 1871. This number opens with a lengthy paper by Græbe and Liebermann on anthracene derivatives; they have studied in detail anthracene carbonic acid, and the behaviour of anthraquinine with phosphoric chloride and potassic hydrate. They have also experimented with the anthraquinine sulpho acids; at the present time researches on this subject possess considerable technical interest, as it is from disulphanthraquinonic acid that artificial alizarin is prepared, which seems to be fast supplanting the use of the madder root in dyeing. Böttger and Petersen follow on a subject nearly allied to the former, "on the compounds of anthraquinone containing nitrogen." Zinneman contributes a paper on an improvement in the method of distillation; the method is somewhat similar to that usually employed in chemical laboratories, that is to cause the vapour to pass up a long upright glass tube on which several bulbs have been blown, the exit tube being at right angles nearly at the top; the new portion of the apparatus consists in placing in the long tube a number of bell-shaped cages made of platinum wire gauze, which fit closely to the sides of the tube, and through which the vapour must pass or filter as it rises in the tube. With this apparatus the author has made an extensive series of experiments on the purification and determination of the boiling points of some of the most important of the ethyl compounds, on various acids of the same series, on the separation of propyl and butyl alcohols from the products of fermentation, and on the separation of the iodides of ethyl, propyl, and butyl. Judging by the results of these experiments, the new contrivance seems to work extremely well, and to be an improvement on the original form of apparatus. Several short papers complete this number, but they are not of extreme interest.

Journal of the Chemical Society, March 1872.—The composition of the natural tantalates and niobates forms the subject of a very important paper by Rammelsberg. Numerous analyses of various minerals containing the two rare elements, tantalum and niobium, are given, the results of which, however, cannot be usefully condensed.—Dr. Tilden presents a note "On the crystalline principle of Barbadoes Aloes;" the author has obtained a chloro-substitution product corresponding to the bromo-derivative, described some years since by Dr. Stenhouse, that is aloïn in which three atoms of hydrogen are replaced by chlorine. The remainder of this number is occupied by the abstracts of foreign papers, many of which are of great interest.—Dr. de Coppet finds that supersaturated solutions of sodic sulphate can be prepared by dissolving the anhydrous salt in cold water; it is, however, necessary that the anhydrous salt should be heated above 33°, and cooled out of contact with the air, as it is found that the anhydrous sodic sulphate, obtained by drying the ordinary salt (containing ten molecules of water) at a temperature lower than 33°, always acts as a nucleus in determining the crystallisation of a supersaturated solution of this salt. From this it appears that from crystallised sodic sulphate different bodies are obtained depending on the temperature at which the salt is dried.—A long abstract of Linnemann's important paper "On an improvement in the method of fractional distillation," and also of his researches on the normal propyl alcohol and its compounds are here given.—Another curious example of the lowering of the boiling point of mixtures of water and other liquids forms the subject of another abstract. Is. Pierre finds that a mixture of water and butyl iodide distils at 95°–96° (butyl iodide boils at 122·5°), and that a constant mixture of 79 parts of iodide and 21 of water is found in the distillate. Ethylic iodide (B.P. 72°) and water distil at 66°, only 3 to 4 per cent. of water condensing with the iodide. The abstracts as a whole are shorter and more condensed than they were originally; in some cases this must be regretted, though in others it is, perhaps, an advantage.

THE *Quarterly Journal of Microscopical Science* for April 1872, contains memoirs on the Development of the Enamel in the Teeth of Mammals, as illustrated by the various stages of growth demonstrable in the evolution of the fourth molars of a young elephant, and of the incisor teeth in the fœtal calf, by Prof. Rolleston, M.D. This paper is a reprint.—Note on Immersion Object-glasses for the Microscope, by Dr. Royston Piggott, chiefly directed towards the assertion that the aperture of an immersion lens can never exceed 80°, which this author denies.—Observations of Pathological Changes in the Red Blood-corpuscle, by J. Braxton Hicks, M.D.—On the Artificial Production of some of the principal Organic Calcareous Formations, by Prof. Harting, of the University of Utrecht. This is an abridged report of researches undertaken with the view of producing, independently of living organisms, certain calcareous formations, which are met with in animals as integral parts of their skeleton, and this by causing calcium carbonate and phosphate to combine in the nascent state with organic substances.—On the Peripheral Distribution of Non-medullated Nerve-Fibres, by Dr. E. Klein; the third part of a memoir, of which the previous portions appeared in this journal. It treats of the relation of the non-medullated nerve-fibres to small arteries, small veins, and to capillary vessels in the muscular substance of the frog's tongue; and the termination of nerve-fibres in the ciliated duct in the tail of the rabbit.—On the Structure of Tendon, by J. Mitchell Bruce, partly in support and partly in controversion of the views of Boll, as detailed in Max Schultze's *Archiv*.—The Embryology of Chrysopa, and its bearing on the Classification of the Neuroptera, by A. S. Packard, Jun., M.D. Reprinted from the *American Naturalist*.—Preliminary notice of Researches on the Anatomy of the Serous Membranes in Normal and Pathological Conditions, by Dr. E. Klein and Prof. Burdon Sanderson, forming a part of investigations on infectious diseases, undertaken for the Medical Department of the Privy Council. These investigations relate to more than 250 animals, especially rabbits and guinea pigs, many frogs, several cats, dogs, some rats, and one monkey.—The remainder of the journal is occupied with abstracts, notices, and reports.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 16.—"On the Specific Heat and other physical characters of Mixtures of Methylic Alcohol and Water, and on certain relations existing between the Specific Heat of a Mixture or Solution, and the Heat evolved or absorbed in their formation," by Dr. A. Dupré.—"On Supersaturated Saline Solutions," Part III., by Charles Tomlinson, F.R.S., and G. Van der Mensbrugghe.—"Remarks on the Sense of Sight in Birds, accompanied by a description of the Eye, and particularly of the Ciliary Muscle in the genus *Raptores*," by Mr. Robert Lee.—Supplement to Mr. Lee's communication on the Sense of Sight in Birds. A Description of the Eye in *Rhea americana*, *Phœnicopterus antiquorum*, and *Aptenodytes Humboldtii*.

Geological Society, May 8.—Mr. Joseph Prestwich, F.R.S., in the chair.—The following papers were read:—1. "Notes on Atolls or Lagoon Islands." By Mr. S. J. Whitnell. The author commenced by indicating certain facts which lead him to think that the areas of atolls are not at present sinking, and referred to one instance (that of Funafuti or Ellice Islands), in which he thought there were signs of a slight upward movement. He noticed the occurrence of a furrowed appearance, or a series of ridges or mounds, in some islands, each of which he regarded as produced by a single gale. He also described a freshwater lagoon, about three miles in diameter, as occurring in the Island of Quiros. Mr. Thorpe was acquainted with the atolls around the coast of Ceylon, and thought that the local traditions, untrustworthy as such sources usually were, might afford some evidence as to the date of their origin. The tradition of Ceylon was that the Maldive and Laccadive Islands had within the memory of many been connected with Ceylon. If this were so the evidence was in favour of the area being one of subsidence. Mr. D. Forbes, when in 1859 he spent some months in the Pacific, had been requested by Mr. Darwin to examine into the evidence as to the origin of these atolls by elevation, and had found that the asserted cases of the existence of masses of coral at a considerable elevation above the sea merely arose from blocks having been transported inland by the natives. Though, however, there was no evidence of elevation, it was still possible that such had in certain cases taken place, as there were still active volcanoes in this region. The freshwater lakes he attributed to the drainage of the islands

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